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AD NUMBER
AD872678
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AUTHORITY
USATEC ltr, 14 Dec 1970

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17 June 1970

Materiel Test Procedure 5-3-055
U. S. Army Field Artillery BoardU. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

MISSILE SYSTEM, FIELD ARTILLERY

1. OBJECTIVE

The purpose of this procedure is to determine the suitability of a missile weapon system to perform the mission as described in the QMR and the suitability of the system and its maintenance package for use by the Army.

2. BACKGROUND

Development of reliable guided missile systems provide Army field commanders with needed and readily responsive means to deliver long range fire support. Continuing research and development has brought about improvement in propulsion and guidance, mobility, ruggedness, reliability, range and accuracy. Continuing requirements for service testing and initial production testing are generated by new development or updating of material.

3. REQUIRED EQUIPMENT

- a. Suitable Hardstand Areas.
- b. Suitable Field Training Areas including improved and unimproved roads.
- c. Suitable Firing Ranges.
- d. Field Storage Areas for missiles, including warheads.
- e. Organization, Direct Support and General Support Maintenance Facilities.
- f. Necessary Tools, Equipment and Repair Parts.
- g. Timing Devices as required.
- h. Communication Support.
- i. Still and Motion Picture Cameras with Film.
- j. Calibration Support of test equipment.
- k. POL as required.
- l. Support equipment (vans, generators, etc.).
- m. Telemetry Equipment, as required.

4. REFERENCES

- A. Department of the Army approved QMR.
- B. USAMC Manual 385-224, AMC Safety Manual.
- C. USAMC Regulation 70-1, Responsibility for Application of Human Factors Engineering in the Evaluation of Army Materiel.
- D. USAMC Regulation 385-12, Verification of Safety of Materiel from Development through Testing and Supply to Disposition.
- E. USATECOM Regulation 70-23, Equipment Performance Report.
- F. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- G. USATECOM Regulation 750-15, Maintenance Portion of the Service Test.
- H. MTP 2-3-500, Preoperational Inspection and Physical Characteristics.
- I. MTP 2-3-504, Cross-Country Mobility.

- J. MTP 2-3-505, Road Mobility.
- K. MTP 2-3-509, Fording.
- L. MTP 5-3-500, Preoperational Inspection and Physical Characteristics.
- M. MTP 5-3-501, Battlefield Mobility, Tactical Flexibility and Portability.
- N. MTP 5-3-502, Manuals and Technical Literature.
- O. MTP 5-3-507, Human Factors Engineering.
- P. MTP 5-3-508, Power Requirements.
- Q. MTP 5-3-509, Adequacy of Lighting, Heating, Air Conditioning and Heating Equipment.
- R. MTP 5-3-510, Safety Hazards.
- S. MTP 5-3-512, Transportability.
- T. MTP 5-3-522, Compatibility with Fire Control Equipment.
- U. MTP 5-3-525, Blackout Conditions Test.
- V. MTP 5-3-527, Field Storage - Missile and Rockets.
- W. MTP 5-3-528, Accuracy.
- X. MTP 5-3-530, Sector of Fire and Changing Targets.
- Y. MTP 5-3-534, Vulnerability to Detection and Identification.
- Z. MTP 5-3-536, Training Devices, (Missile and Rocket System).
- AA. MTP 10-3-501, Operator Training and Familiarization.

5. SCOPE

5.1 SUMMARY

This MTP describes the following procedures used to determine the suitability of missile systems:

a. Preparation for Test - A verification of the physical characteristics of the test item and a determination of its condition upon arrival at the test site; and a determination of training requirements.

b. Operational Performance consisting of:

- 1) Occupation of Position and Displacement - An evaluation of the time required to occupy a position and prepare to fire, and to displace the test item from its firing position under various environmental conditions while operating over various terrain.
- 2) Readiness and Reaction Time - An evaluation to determine the time required to fire under various conditions of readiness.
- 3) Mobility - A determination of the test items mobility over various types of terrain, battlefield mobility and tactical flexibility and swimming capability.
- 4) Range - A determination of the usable range, maximum and minimum, of the missile system.
- 5) Rate-of-Fire - A determination of the maximum and sustained rate-of-fire of the test system.
- 6) Firing Table Evaluation and Missile Accuracy - A determination of missile accuracy and firing table adequacy and accuracy.

c. Reliability - A determination of the pre-flight, in-flight and overall reliability of the test system.

d. Field Storage - A determination of the effect of storage on the missile system.

e. Maintenance - An evaluation of the suitability of the test item and its maintenance package for scheduled and non-scheduled maintenance tasks.

f. Safety - An evaluation to determine the test item compliance with safety requirements, and to confirm the test item's safety characteristics during conduct of all tests.

g. Vulnerability to Detection - A determination of the ease of detection and identity of tactical missile systems.

h. Power Requirements - A determination of the adequacy of the supplied power source(s).

i. Adequacy of Lighting, Ventilation, Air Conditioning and Heat - A determination of the adequacy of and the effect of the system environmental control sections on crew performance.

j. Human Factors Engineering - A study to determine the suitability of the test item for operation by service personnel without causing undue fatigue, strain or mental errors.

k. Transportability - A study to determine the capability of the test item to be transported by various means.

l. Training Devices - An evaluation of the effectiveness of the training devices used.

m. Compatibility with Related Equipment - An evaluation of the compatibility of the test system with items of related equipment.

n. Training Manuals and Technical Literature Evaluation - An evaluation of the adequacy of accuracy of supplied literature.

5.2 LIMITATIONS

With the exception of mobility testing (paragraph 6.2.1.3), this procedure does not include procedures for tactical vehicles assigned to the missile system.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Training

a. Ensure the availability of service personnel who have been trained using the criteria of MTP 10-3-501 in conjunction with the appropriate technical publications and training manuals of MTP 5-3-502 and training devices of MTP 5-3-536 and are cognizant of the handling, maintaining, loading/unloading and safety hazard aspects of the test item and the object of the procedure.

NOTE: Normally a TOE unit will be placed under operational control of the USA Field Artillery Board to provide these personnel and the necessary command, control, operations and maintenance personnel and facilities.

- b. Record the adequacy and correctness of supplied literature.
- c. Record the adequacy of training devices.

NOTE: Final evaluation of adequacy and correctness of training literature and devices shall be made at the completion of testing.

6.1.2 Preoperational Inspection and Test Item Characteristics

6.1.2.1 Preoperational Inspection

Conduct an inspection of the test item as described in the applicable sections of MTP 5-3-500 including receipt inspections according to applicable end item DTM and DOMM.

6.1.2.2 Physical Characteristics

- a. Determine and record the dimensions, weight and other pertinent physical characteristics of, the test item missile, launcher and other system peculiar equipment.
- b. Photograph the items of step a.

6.1.3 Facilities and Equipment

a. Select and schedule the use of appropriate firing ranges, telemetry equipment, and flash observation posts in accordance with the provisions of MTP 5-3-528.

b. Upon notice of the arrival of estimated time of arrival of the test item, arrange for, or secure the following:

- 1) Engineering Safety Release or a Safety Statement from the engineering agency for the missile system and missiles to be fired as prescribed by references 4D and 4F.
- 2) Equipment, special facilities, and instruments listed under paragraph 3 and requisition any additional supplies or special equipment not readily available at the test site.
- 3) On-site location of spare parts basic load.
- 4) Maintenance support facilities, organization and personnel.
- 5) Prepare firing positions by surveying the site, installing communications and performing necessary pioneer work.

c. Safe test procedures shall be followed throughout testing. All test operations shall be observed by project personnel and any unsafe or potentially unsafe conditions will be cause for testing to cease until all questionable conditions are resolved.

6.2 TEST CONDUCT

Subtests shall be conducted concurrently with, or in conjunction with, other subtests, whenever possible, so that the time taken to collect the required data can be minimized.

6.2.1 Operational Performance

Subject the test system(s) to simulated tactical operations, as applicable, while observing the following guidelines:

- a. All firing and non-firing exercises will be conducted under conditions approximating a tactical environment.
- b. Average-trained soldiers will be used.
- c. Every effort will be made to utilize weather extremes encountered during the test period.
- d. Where the test item is designed to replace an existing item, appropriate comparison will be made.
- e. When the test item is capable of more than one operational configuration i.e. towed and self-propelled, each configuration will be tested as appropriate.
- f. Where live missile components are prescribed for use during non-firing tests, their use is dependent upon a valid safety release.

6.2.1.1 Occupation of Position and Displacement

NOTE: Perform the procedures of paragraphs 6.2.1.1.1 and 6.2.1.1.2 using live components with the possible exception of nuclear components, initiators and other components removed to preclude launch and safety hazards.

6.2.1.1.1 Occupation - Perform the following:

a. Occupy a prepared position (surveyed, communications installed and pioneer work performed) on flat turf during daylight hours in clear weather and moderate temperature and humidity conditions, so that the test system will be in the highest readiness posture possible without having received a specific fire mission (the system will be in condition to permit the entry of a fire mission, including yield or type of warhead, and the start of a firing countdown) and record the time using the following criteria:

- 1) Time will start when the first piece of system equipment arrives at the surveyed stake or other means used to mark its position.
- 2) Time will stop when the system is in a ready condition (launcher emplaced, external fire control equipment emplaced, and missile and warhead available).

NOTE: 1. Systems capable of carrying a missile, less warhead, on the launcher will have the launcher so loaded.
2. Systems capable of checking the missile and warhead either in or out of containers will have those checks completed.

- b. Record the details of any unusual occurrences.
- c. Repeat the procedures of steps a and b a minimum of five times so as to obtain the longest, shortest and average time required for occupation.

d. Repeat the procedures of steps a through c on the following terrain:

- 1) Rocky.
- 2) Sandy.
- 3) On the forward slope of a hill.
- 4) On the reverse slope of a hill.
- 5) On a slope which causes the launcher to cant to the left.
- 6) On a slope which causes the launcher to cant to the right.
- 7) On a combination of steps d.3 and d.5, and a combination of steps d.3 and d.6.
- 8) On a combination of steps d.4 and d.5, and a combination of steps d.4 and d.6.

e. Repeat the procedures of steps a through d under the environmental conditions listed in the QMR or the following, as applicable:

- 1) Moderate temperature with rain
- 2) Frigid temperatures with:
 - a) Snow
 - b) Sleet or icy conditions
- 3) Hot temperatures with:
 - a) High humidity
 - b) Low humidity

f. Repeat the procedures of steps a through e under conditions of blackout in accordance with MTP 5-3-525.

6.2.1.1.2 Displacement - Perform the following:

a. Tactically displace the test unit from a firing position on flat turf during daylight hours in clear weather and moderate temperature and humidity conditions, when in the following conditions, and record the time:

NOTE: The test unit will be considered displaced, and timing will stop, when the firing section is ready to move out of the firing position. (Test personnel will ascertain that all elements of the system peculiar equipment are in fact ready to displace - all equipment properly loaded and engines running.)

- 1) The missile is loaded on the launcher mated to a warhead

NOTE: Timing will start when the fire unit commander is ordered to displace.

- 2) Immediately after firing.

NOTE: Timing will start when the missile is fired or a simulated firing has been accomplished.

- b. Record the details of any unusual occurrences.
- c. Repeat the procedures of steps a and b under the conditions

stipulated in steps c through f of paragraph 6.2.1.1.1.

6.2.1.2 Readiness and Reaction Time

NOTE: The following procedures shall be performed using the following guidelines:

- 1) All operations will be timed.
- 2) Where a success results after holds have been called for other than system failures, hold times will be subtracted and mission times reconstructed accordingly.
- 3) Where system failures occur after holds have been called for other than system failures, the operation will be considered no test.
- 4) Where failures occur that result in a complete abort the operation will be considered in final results.
- 5) All readiness and reaction exercises will be designated as and operation on which reaction times will be measured. At no time will the decision to time or monitor an operation be made after the start or completion of an operation.
- 6) All components will be in a condition from which a success can be expected. Ground rules for each condition will be listed. They include a successful operation or self check immediately preceding the operation of road march. In-container checks are sufficient when they are provided.
- 7) Time necessary to correct personnel errors should be subtracted from the total time.
- 8) If the QMR ties reliability to reaction time see Appendix A for Guidelines regarding data collection.

a. Perform the following on flat turf during daylight hours in clear weather and moderate temperature and humidity conditions, as applicable:

- 1) Occupy a firing position.
- 2) Prepare the missile system for action.
- 3) Checkout the missile and fire or simulate firing.
- 4) March order the test system and displace it from its firing position.

b. Record the time required to perform the individual procedures of step a and the time required to fire (or simulate firing) from the following conditions:

- 1) System in a traveling condition with equipment in the lowest state of readiness (missile components in containers and power off on all ground support equipment). Time will start when the first carrier stops at its predesignated location.
- 2) System in a traveling position with the equipment in the highest state of readiness (fire mission received to include designated warhead). Time will start when the first carrier stops at its predesignated location.

- 3) System emplaced with the equipment in the highest state of readiness without a fire mission or a warhead designated. Time will start when the fire mission is received. For systems with a limited sector of fire two exercises will be conducted; one requiring and one not requiring repositioning of the launcher.
- 4) System emplaced with the equipment in the highest state of readiness (fire mission received, less time on target and the system in a hold condition as specified in the QMR).
- 5) The system in a hold condition at various times and for varying durations as specified in the QMR.
- 6) The system in a hold condition and a new target designated that does not require the change of warhead. For systems with a limited sector of fire, two types of exercises will be conducted, one requiring and one not requiring the repositioning of the launcher.

c. Record the details of any unusual occurrences.

d. Repeat the procedures of steps a through c under the conditions stipulated in steps c through f of paragraph 6.2.1.1.1.

6.2.1.3 Mobility

Perform the following on tactical vehicles provided with the missile system:

a. Subject the test vehicles to the applicable inspection procedures of MTP 2-3-500 and record all pertinent data.

b. Operate the vehicles, combat loaded, over improved and unimproved roads and cross-country terrain, at speeds as indicated in the QMR or at the speeds of comparable units employed at the same level (e.g., division field artillery or army field artillery) when QMR direction is missing, and record the following as described in the applicable sections of MTP 2-3-504, MTP 2-3-505 and MTP 5-3-501 and record all pertinent data including the following:

- 1) Effects of terrain and weather
- 2) Equipment malfunctions
- 3) Maximum usable speed under each test condition

c. If required, subject the test vehicle to the swimming operations of MTP 2-3-509 and record all pertinent data.

d. At the completion of each of the operations of steps b and c subject the test vehicle to the applicable inspection procedures of step a.

6.2.1.4 Range

Determine the usable range of the test item as follows:

- a. During the various firing tests of paragraph 6.2.1.1, 6.2.1.2, 6.2.1.5 through 6.2.1.7 fire the test item at the maximum and

minimum ranges specified in the QMR and at a minimum of three equispaced ranges between maximum and minimum and record the following:

- 1) Coordinate of the firing position
- 2) Intended burst point
- 3) Actual burst point

b. Analyze the following firings to determine if they can be used to increase the sample size of step a:

- 1) Tactical consideration are compromised in order to achieve engineering objectives.
- 2) Ballistics may be altered by the addition of weight because of instrumentation or other requirements and for usable firings record the data of step a and indicate compromise made.

6.2.1.5 Rate of Fire

Determine the rate of fire for the test missile system as follows:

- NOTE:
1. When equipment failure occurs during the conduct of the test, only those means that would be available in a tactical situation will be used to correct the failures.
 2. All non-firing exercises conducted to determine the rate of fire will be conducted using live components with the possible exception of nuclear components, initiators and other components removed to preclude launch or safety hazards. However training item can be used where the requirement for a larger number of tests would exceed the design criteria for the tactical equipment.
 3. Particular care shall be made to separate non-tactical time from system times.

a. During specified firing and non-firing exercises measure and record the following:

- 1) Time required to checkout and assemble missiles and be ready to fire.
- 2) Time interval between firing one missile from a launcher and being ready to fire another missile at a different target from the same launcher.

b. Determine the test system's maximum rate of fire, during non-firing exercises using the following guidelines:

- 1) Starting conditions will assume that a missile has just been fired and an adequate supply of ready missiles and handling is available in the firing position.
- 2) When measuring time, the time delay between firing and loading a new missile onto the launcher caused by the removal of the training missile from overall missile fire/missile re-load time.

- 3) Load/fire and reload/fire the test item for a minimum of ten rounds or as otherwise specified.

c. Determine the maximum sustained rate of fire for the test item, using the following guidelines:

- 1) The test shall commence with the system:
 - a) Emplaced and all required equipment and personnel available.
 - b) In the highest state of readiness without receipt of a fire mission.
- 2) Time will start when the fire mission is received.
- 3) Only the firing units based load of ammunition will be immediately available to the fire unit, resupply will be effected under realistic operational conditions if required to sustain the rate of fire defined in the QMR.
- 4) If an overall time is not specified, a 24-hour period will be used.

6.2.1.6. Sectors of Fire and Changing Targets

- a. Determine the test item's sector of fire as described in the applicable section of MTP 5-3-530.
- b. Determine the ability of the test item to change targets, after a missile with warhead has been readied for firing at a given target, as described in the applicable section of MTP 5-3-530.

NOTE: On specific tests the missile will be fired at the second target, while on other tests the firing will be simulated.

6.2.1.7 Firing Table Evaluation and Missile Accuracy

Determine the adequacy of the system firing table and missile accuracy as follows:

- a. Perform the applicable procedures of MTP 5-3-528.
- b. On all firing tests of paragraphs 6.2.1.1, 6.2.1.2, 6.2.1.5 and 6.2.1.6 data contained in the firing tables shall be used to compute firing commands and the following shall be recorded:

- 1) Firing commands used.
- 2) Omissions in the tables.
- 3) Trajectory data including range, direction and height of burst.
- 4) Deviations attributable to the firing tables.
- 5) Miss data.
- 6) Ease of use of the tables.

NOTE: If provided, a computer machine program shall be evaluated

as a part of this procedure.

6.2.2 Reliability

Determine the pre-flight, in-flight and system reliability of the test system by performing the following:

NOTE: 1. Pre-flight reliability applies to missiles in two categories:

- a. Missiles coming from storage, both field and depot under conditions described in the QMR and processed for firing.
- b. Missile carried in a ready-to-fire condition.

2. In-flight reliability is divided into two components:

- a. The missile less the warhead.
- b. The warhead component.

3. System reliability is the product of pre-flight and in-flight reliabilities.

a. Assure that the system and/or components are in such condition as to be reported normally as operational by the tactical commander (i.e., a firing set must have completed a successful self-check prior to initiation of a firing sequence or the firing set must have completed a successful operation prior to initiating a self-check and requisite periodic maintenance must have been successfully accomplished).

NOTE: In the case of missiles coming from warehouse storage or field storage missiles will be operational when placed in such storage.

b. Include all firing and non-firing exercises in the data collection process for the determination of reliability.

c. Include in the evaluation all operations for which at the outset a success can be anticipated.

NOTE: 1. When significant error-producing operations are identified in the Human Engineering subtest, the results of these errors shall be considered in assessing system reliability and not be charged as personnel errors and subsequently disregarded in system reliability computations.

2. Data obtained from test conducted prior to service tests and from engineering tests shall be carefully scrutinized, where these data appear to be adequate from a user point of view, they will be used to increase the sample size of data obtained from the service test.

d. Record the following for each firing exercise:

1) For each failure:

- a) System component involved (missile, warhead - ground support equipment).
- b) Phase in which failure occurred (pre-flight, in-flight).
- c) Whether malfunction was verified by appropriate maintenance personnel.
- d) Deviation from prescribed test criteria, if any.

2) Critical time elements when applicable:

- a) Time operation started
- b) Time of hold and reason
- c) Time operation was resumed
- d) Time operation was concluded
- e) Time interval between scheduled and actual firing time

6.2.3 Field Storage

Determine the effects of field storage by performing the procedures of MTP 5-3-527 and recording the following:

- a. Data required by MTP 5-3-527.
- b. Time and nature of repairs and maintenance performed.
- c. Result of storage monitoring tests.
- d. Time required to remove missiles and warhead sections from containers.
- e. Details of any unusual occurrences.

6.2.4 Maintenance

a. Perform all authorized organizational maintenance functions and a sampling of direct and general support maintenance functions listed on the maintenance allocation chart on each item of materiel in the missile system including warhead sections and all associated equipment tested concurrently.

b. Evaluate and record any inadequacy in the following:

- 1) Tools
- 2) Repair parts
- 3) Test equipment
- 4) Personnel allocation
- 5) Technical instructions and manuals
- 6) Spare part interchangeability

c. Determine and record whether any special tools can be adequately replaced with common tool(s).

d. Review and record any maintenance operations which cannot be performed within prescribed time standards and skill levels.

e. Record the following:

- 1) Description scheduled and of unscheduled maintenance performed,

- parts used and man-hours required.
- 2) Time consuming or difficult maintenance operations and material characteristics prejudicial to ease and speed of maintenance.
 - 3) Safety hazards relative to maintenance.
 - 4) Human engineering aspects of maintenance.
 - 5) Excessive maintenance requirements to include frequency and adequacy of scheduled maintenance.
 - 6) Maintenance operations which should be reassigned to a different category or echelon of maintenance.

6.2.5 Safety

Determine the safety characteristics of the test system as described in applicable sections of MTP 5-3-510 and by performing the following:

- a. On all tests, operations will be observed to detect unsafe conditions and conditions which would tend to produce an unsafe condition.
- b. Record details of:
 - 1) Materiel characteristics which cause unsafe conditions.
 - 2) Operating procedures which are hazardous for crewmen or which may cause damage to materiel.
 - 3) Conditions which endanger friendly troops.

6.2.6 Vulnerability to Detection

Determine the vulnerability to detection of the test system as described in applicable sections of MTP 5-3-534.

NOTE: These procedures shall be performed by the appropriate agency as provided for in the test directive, they shall not be the responsibility of the USA Field Artillery Board.

6.2.7 Power Requirements

Determine the suitability of the power sources servicing the test system as described in applicable sections of MTP 5-3-508.

6.2.8 Adequacy of Lighting, Ventilation, Air Conditioning and Heat

Determine the adequacy of lighting ventilation, air conditioning and heat as described in applicable sections of MTP 5-3-509.

6.2.9 Human Factors Engineering

a. Evaluate the human factors aspects of the test system as described in applicable sections of MTP 5-3-507 throughout all testing with a view to identifying error-producing designs and operations. Specific tests for design adherence to specified human engineering standards will be assumed to have occurred during engineering design tests and during the engineering

test. Where variations are noted, they will be assumed to be the result of tradeoff studies unless the resulting design produces, or is likely to produce, errors.

b. All errors noted during tests will be recorded on an error report form. Errors will be analyzed to determine if equipment design is a contributing factor.

6.2.10 Transportability

Determine the transportability characteristics of the test system as described in the applicable sections of MTP 5-3-512.

6.2.11 Training Devices

Evaluate the suitability and adequacy of the test item, as regards assembly/disassembly, set-up and operation, maintenance and interchangeability of parts with the system under test using the applicable procedures of MTP 5-3-536.

6.2.12 Compatibility with Related Equipment

Determine the compatibility of the test system with related equipment as described in applicable sections of MTP 5-3-522.

6.2.13 Training Manuals and Technical Literature Evaluation

Throughout testing, while utilizing the supplied literature during operation and maintenance procedure, evaluate the adequacy and accuracy of the literature and record the following:

- a. Modifications required to the existing literature to optimize operating and maintenance instructions.
- b. Details concerning errors, omissions, unsafe procedures and other inadequacies.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Training

Record the data collected as described in applicable sections of MTP 10-3-501 and the following.

- a. Adequacy and correctness of supplied literature
- b. Adequacy of training devices

6.3.1.2 Preoperational Inspection and Physical Characteristics

- a. Record the following:

- 1) Data collected as described in applicable sections of MTP 5-3-500.
- 2) For each system peculiar equipment.
 - a) Equipment (launcher, missile, etc)
 - b) Weight in pounds
 - c) Dimensions in feet and inches
 - d) Other physical details of test item

b. Retain all photographs

6.3.2 Test Conduct

6.3.2.1 Operational Performance

6.3.2.1.1 Occupation of Position and Displacement -

Record the following:

a. For all testing:

- 1) Lighting condition (day, blackout)
- 2) For meteorological conditions:
 - a) Weather (clear, rain, snow, etc)
 - b) Temperature in °F
 - c) Relative humidity in %
- 3) Terrain (turf, rock, soil, forward slope of hill, etc)

b. For occupation of position:

- 1) For each occupation procedure:
 - a) Run number (1, 3, etc)
 - b) Time required to occupy position in minutes
- 2) Details of any unusual occurrences

c. For displacement:

- 1) For each displacement procedure:
 - a) System condition (launcher loaded, after firing)
 - b) Run number (1, 3, etc)
 - c) Time required to displace in minutes
- 2) Details of unusual occurrences

6.3.2.1.2 Readiness and Reaction Time -

Record the following for each test performed:

- a. Lighting condition (day, blackout)
- b. For meteorological conditions:
 - 1) Weather (clear, rain, etc)
 - 2) Temperature in °F
 - 3) Relative humidity in percent
- c. Time required, as applicable, in minutes, to:
 - 1) Occupy a firing position
 - 2) Prepare the missile system for action
 - 3) Checkout the missile
 - 4) Fire or simulate firing
 - 5) March order the test item
 - 6) Displace the test item
- d. Time required to fire (or simulate firing), in minutes with system:
 - 1) In traveling condition in lowest state of readiness.
 - 2) In traveling condition in highest state of readiness.
 - 3) Emplaced in highest state of readiness less fire mission or warhead designated.
 - 4) Emplaced in highest state of readiness (fire mission received)
 - 5) System in hold condition for various time and durations as specified in QMR.
 - 6) System in hold conditions and new target designated:
 - a) Repositioning not required
 - b) Repositioning required
- e. Details of any unusual occurrences

6.3.2.1.3 Mobility -

Record the following:

- a. Applicable inspection data collected as described in MTP 2-3-500:
 - 1) Prior to testing
 - 2) After each mobility test
- b. Level of operation (division field artillery, army field artillery)
- c. Mobility data collected as described in the following:
 - 1) MTP 2-3-504 for cross-country mobility
 - 2) MTP 2-2-505 for road mobility
 - 3) MTP 2-3-509 for swimming capability, if required
 - 4) MTP 5-3-501 for battlefield mobility

- d. Effects of weather and terrain
- e. Equipment malfunctions
- f. Maximum usable speed under each test condition in mph

6.3.2.1.4 Range -

Record the following:

- a. For each firing data information used:
 - 1) Description of data (service test, engineer/engineer design test, etc).
 - 2) Coordinates of the firing position.
 - 3) Range in meters.
 - 4) For burst point, in coordinates:
 - a) Intended
 - b) Actual
- b. Compromise made during firing (added ballistic weight, etc).

6.3.2.1.5 Rate of Fire -

Record the following:

- a. Time required in minutes to checkout, assemble and prepare missile for firing.
- b. Time interval between firing one missile and being ready to fire another, at a different target, in minutes.
- c. Maximum rate of fire in missiles/hour.
- d. Maximum sustained rate of fire in missiles/hour.

6.3.2.1.6 Sectors of Fire and Changing Targets -

Record data collected as described in the applicable sections of MTP 5-3-530.

6.3.2.1.7 Firing Table Evaluation and Missile Accuracy -

Record the following:

- a. Accuracy data collected as described in the applicable sections of MTP 5-3-528.
- b. For firing table evaluations:
 - 1) Firing commands used
 - 2) Omissions in the tables
 - 3) For trajectory data:
 - a) Range in meters
 - b) Direction

c) Height of burst in meters

- 4) Deviations attributable to the firing tables
- 5) Miss data
- 6) Ease of use of the tables

c. Adequacy and accuracy of computer machine program, if applicable

6.3.2.2 Reliability

Record the following for each firing exercise:

a. For each failure

- 1) System component involved (missile, warhead, ground support equipment).
- 2) Phase in which failure occurred (pre-flight, in-flight).
- 3) Whether malfunction was verified by appropriate maintenance personnel.

b. Deviation from prescribed test criteria, if any.

c. Critical time elements when applicable:

- 1) Time operation started
- 2) Time of hold and reason
- 3) Time operation was resumed
- 4) Time operation was concluded
- 5) Time interval between scheduled and actual firing time

6.3.2.3 Field Storage

Record the following:

- 5-3-527.
- a. Data collected as described in the applicable sections of MTP
 - b. Time and nature of any repairs or maintenance performed.
 - c. Discrepancies noted during storage monitoring.
 - d. Time required to remove missile and warhead sections from containers.
 - e. Details concerning any unusual occurrences.

6.3.2.4 Maintenance

Record the following:

a. Any inadequacy in the following:

- 1) Tools
- 2) Repair parts
- 3) Test equipment
- 4) Personnel allocation

- 5) Technical instructions and manuals
- 6) Spare part interchangeability
- b. Any special tool replaceable with common tool(s).
- c. Maintenance not performed within prescribed time standard and skill levels.
- d. Description of unscheduled maintenance performed including:
 - 1) Parts used
 - 2) Man hours required
 - 3) Time consuming maintenance operations
 - 4) Safety hazards relative to maintenance
 - 5) Human factor aspects of maintenance
 - 6) Excessive maintenance requirements
 - 7) Maintenance operation which should be reclassified

6.3.2.5 Safety

Record the following:

- a. Data collected as described in applicable section of MTP 5-3-510.
- b. Materiel characteristics which cause unsafe conditions.
- c. Operating procedures which are hazardous for crewmen or which may cause damage to materiel.
- d. Conditions which endanger friendly troops.

6.3.2.6 Vulnerability to Detection and Countermeasures

Record the data collected as described in the applicable sections of MTP 5-3-534.

6.3.2.7 Power Requirements

Record the data collected as described in applicable sections of MTP 5-3-508.

6.3.2.8 Adequacy of Lighting, Ventilation, Air Conditioning and Heat as described in applicable sections of MTP 5-3-509.

6.3.2.9 Human Factors Engineering

Record the data collected as described in applicable sections of MTP 5-3-507.

6.3.2.10 Transportability

Record the data collected as described in applicable sections of MTP 5-3-512

6.3.2.11 Training Devices

Record the data collected as described in the applicable sections of MTP 5-3-536.

6.3.2.12 Compatibility with Related Equipment

Record the data collected as described in the applicable sections of MTP 5-3-522.

6.3.2.13 Training Manuals and Technical Literature Evaluation

Record the following:

- a. Modifications required to the existing literature
- b. Details concerning:
 - 1) Errors
 - 2) Omissions
 - 3) Unsafe procedures
 - 4) Other inadequacies

6.4 DATA REDUCTION AND PRESENTATION

- a. Data obtained from each performance subtest shall be analyzed and summarized. If appropriate, use charts and graphs to show the summary and any comparisons made.
- b. For common tests, present the data as recommended in the referenced MTP.
- c. Compare all qualitative data collected and the various lighting, environmental and terrain conditions and evaluate it against the requirements of the QMR and the degree of fulfillment.
- d. Determine and present the probability of the test system meeting the specified QMR reaction time and reliability using the guidelines of Appendix A.
- e. Prepare a safety confirmation in accordance with the provisions of USATECOM Regulation 385-6.

APPENDIX A

RELIABILITY, REACTION TIME, GUIDELINES

Recently, missile QMR's have tied Reliability to Reaction Time. The following procedures are applicable to the evaluation of both factors:

1. Reaction Time

- a. Take all runs and strip out No Tests and runs in which failures occurred.

NOTE: If the sample size is too small, time to detect, correct, and verify the fix of a failure may be stripped out and the remaining time counted as a successful run.

- b. Strip out times to correct personnel errors and administrative holds to obtain N "perfect" runs, each run having time i .
c. What you have now is N "perfect" runs.
d. Put the run times in ascending order, and label the time i_x , where x goes from 1 to N, and allows you to pick any particular i in the series.
e. The cumulative probability may now be computed using the formula:

$$P(\leq i_x) = \frac{x}{N+1}$$

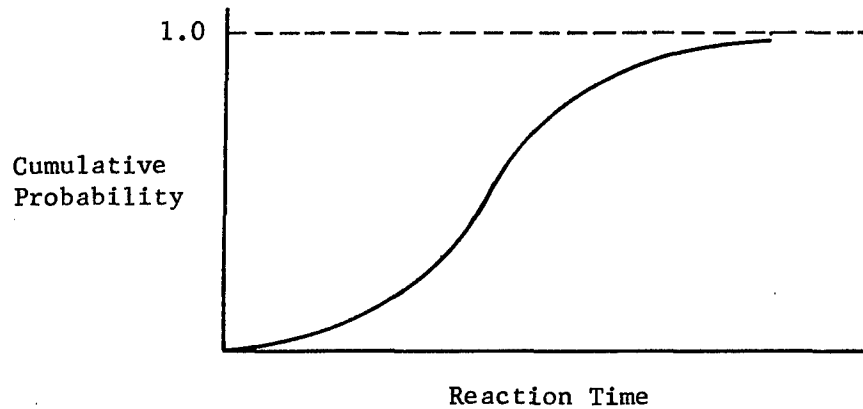
The cumulative probability in this case is the probability that the reaction time will be less than or equal to the reaction time being considered. Thus, the probability that the reaction time will be less than or equal to the third run time in the ascending order (i_3) is:

$$\frac{3}{N+1}$$

- f. Two things become clear upon consideration of the equation

$$P(\leq i_x) = \frac{x}{N+1} . \text{ They are:}$$

- 1) The denominator is an approximation whose accuracy increases as the sample size N increases.
 - 2) It is this (N+1) factor which prevents the cumulative probability from achieving a value of 1.0. This is important because it is impossible to be certain that an event such as is being considered here will ever occur within a certain time period. All cumulative probability curves approach the value $P = 1.0$ asymptotically.
- g. Now plot cumulative probability verses reaction time, and the function will resemble the following:



- h. This curve shows the probability of meeting the QMR specified reaction time.

2. Reliability

- a. Take all runs and strip out No Tests.
- b. Of the remaining runs, strip out the administrative holds and times to correct personnel errors.
- c. This leaves N' runs, including runs with equipment failures. Each run having time of i .
- d. Follow the same procedure^x as for Reaction Time to obtain probabilities and a curve.
- e. This curve indicates the probability of attaining the QMR specified reaction time with fallible equipment and infallible operators.

MTP 5-3-055
17 June 1970

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION Unclassified
		2b. GROUP -----
3. REPORT TITLE U. S. Army Test and Evaluation Command Materiel Test Procedure 5-3-055, Commodity Service Test Procedure, - "Missile System, Field Artillery".		
4. DESCRIPTIVE NOTES (Type of report and, inclusive dates) Final		
5. AUTHOR(S) (First name, middle initial, last name) -----		
6. REPORT DATE 17 June 1970	7a. TOTAL NO. OF PAGES 24	7b. NO. OF REFS 27
8a. CONTRACT OR GRANT NO. DA-18-001-AMC-1045(R)	9a. ORIGINATOR'S REPORT NUMBER(S) MTP 5-3-055	
b. PROJECT NO. AMCR 310-6		
c. -----	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----	
d. -----		
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11. SUPPLEMENTARY NOTES -----	12. SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT This Army Service Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Missile Weapon Systems, and for determining their suitability for service use by the U. S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.		

DD FORM 1473 (PAGE 1)

1 NOV 65
S/N 0101-807-6811

UNCLASSIFIED

Security Classification

A-31408

MTP 5-3-055
17 June 1970

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Army Service Test						
Missile Weapon Systems						
Test Procedures						
Test Methods and Techniques						

DD FORM 1473 (BACK)
1 NOV 65
G/N 0101-807-6821

UNCLASSIFIED
Security Classification

A-31403

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